

**IN THE CLAIMS:**

- 1 1. (Currently Amended) A method for a storage operating system implemented in a  
2 storage system to optimize the amount of readahead data retrieved for a read stream es-  
3 tablished in a data container stored in the storage system, the method comprising:  
4       receiving a client read request at the storage system, the client read request indi-  
5 cating client-requested data for the storage operating system to retrieve from the data  
6 container containing the read stream;  
7       determining whether the storage operating system is permitted to retrieve reada-  
8 head data from the data container in response to the received client read request;  
9       if it is determined that the storage operating system is permitted to retrieve reada-  
10 head data from the data container, performing the steps of:  
11       (i)     selecting an amount of readahead data to retrieve from the data container  
12               based on a plurality of factors stored within a readset data structure associ-  
13               ated with the read stream; and  
14       (ii)    retrieving the selected amount of readahead data from the data container.
- 1 2. (Original) The method of claim 1, wherein the data container is a file, directory, vdisk  
2 or lun.
- 1 3. (Original) The method of claim 1, wherein the storage operating system is determined  
2 to be permitted to retrieve readahead data from the data container when the client-  
3 requested data extends the read stream past a predetermined next readahead value.
- 1 4. (Original) The method of claim 3, wherein the predetermined next readahead value is  
2 stored in a readset data structure associated with the read stream.

- 1 5. (Original) The method of claim 3, wherein the predetermined next readahead value is  
2 updated based on a percentage of the selected amount of readahead data.
- 1 6. (Previously Presented) The method of claim 1, wherein a read-access style associated  
2 with the data container is one of the plurality of factors used to select the amount of  
3 readahead data.
- 1 7. (Original) The method of claim 6, wherein the selected amount of readahead data  
2 equals zero if the read-access style corresponds to a random read-access style.
- 1 8. (Previously Presented) The method of claim 1, wherein a number of client read re-  
2 quests processed in the read stream is one of the plurality of factors used to select the  
3 amount of readahead data.
- 1 9. (Original) The method of claim 8, wherein the number of client read requests proc-  
2 essed in the read stream is stored as a count value in a readset data structure associated  
3 with the read stream.
- 1 10. (Previously Presented) The method of claim 1, wherein the amount of client-  
2 requested data is one of the plurality of factors used to select the amount of readahead  
3 data.
- 1 11. (Original) The method of claim 10, wherein the selected amount of readahead data is  
2 set equal to a predetermined upper limit for large amounts of client-requested data.
- 1 12. (Original) The method of claim 1, wherein the selected amount of readahead data is  
2 doubled if the number of client read requests processed in the read stream is greater than  
3 a first threshold value.

1 13. (Original) The method of claim 1, wherein the client-requested data is identified as  
2 read-once data when either (i) the number of client read requests processed in the read  
3 stream is greater than a second threshold value or (ii) a set of metadata associated with  
4 the read stream indicates that the client-requested data is read-once data.

1 14. (Original) The method of claim 1, wherein the selected amount of readahead data is  
2 stored in one or more buffers enqueued on a flush queue, the flush queue being config-  
3 ured to reuse buffers after a predetermined period of time.

1 15. (Original) The method of claim 14, wherein the predetermined period of time equals  
2 two seconds.

1 16. (Currently Amended) An apparatus configured to implement a storage operating sys-  
2 tem that optimizes the amount of readahead data retrieved for a read stream established in  
3 a data container stored in the apparatus, the apparatus comprising:

4 means for receiving a client read request, the client read request indicating client-  
5 requested data for the storage operating system to retrieve from the data container con-  
6 taining the read stream;

7 means for determining whether the storage operating system is permitted to re-  
8 trieve readahead data from the data container in response to the received client read re-  
9 quest;

10 means for selecting an amount of readahead data to retrieve from the data con-  
11 tainer based on a plurality of factors stored within a readset data structure associated with  
12 the read stream; and

13 means for retrieving the selected amount of readahead data from the data con-  
14 tainer.

1 17. (Original) The apparatus of claim 16, wherein the data container is a file, directory,  
2 vdisk or lun.

1 18. (Original) The apparatus of claim 16, wherein the storage operating system is deter-  
2 mined to be permitted to retrieve readahead data from the data container when the client-  
3 requested data extends the read stream past a predetermined next readahead value.

1 19. (Original) The apparatus of claim 18, further comprising means for updating the pre-  
2 determined next readahead value based on a percentage of the selected amount of reada-  
3 head data.

1 20. (Previously Presented) The apparatus of claim 16, wherein the plurality of factors  
2 used to select the amount of readahead data includes at least one of:

- 3 (i) the amount of client-requested data,  
4 (ii) a number of client read requests processed in the read stream, and  
5 (iii) a read-access style associated with the data container.

1 21. (Original) The apparatus of claim 16, wherein the selected amount of readahead data  
2 is doubled if the number of client read requests processed in the read stream is greater  
3 than a first threshold value.

1 22. (Currently Amended): A storage system configured to optimize the amount of reada-  
2 head data retrieved for a read stream established in a data container stored in the storage  
3 system, the storage system comprising:

4 a network adapter for receiving a client read request, the client read request indi-  
5 cating client-requested data to retrieve from the data container containing the read stream;  
6 and

7 a memory configured to store instructions for implementing a storage operating  
8 system that performs the steps of:

9 determining whether the storage operating system is permitted to retrieve  
10 readahead data from the data container in response to the received client read re-  
11 quest, and

12                   if it is determined that the storage operating system is permitted to retrieve  
13           readahead data from the data container:

14                   (i)       selecting an amount of readahead data to retrieve from the  
15                   data container based on a plurality of factors stored within a readset data  
16                   structure associated with the read stream; and

17                   (ii)       retrieving the selected amount of readahead data from the  
18           data container.

1   23. (Original) The storage system of claim 22, wherein the data container is a file, direc-  
2   tory, vdisk or lun.

1   24. (Original) The storage system of claim 22, wherein the storage operating system is  
2   determined to be permitted to retrieve readahead data from the data container when the  
3   client-requested data extends the read stream past a predetermined next readahead value.

1   25. (Original) The storage system of claim 24, wherein the predetermined next reada-  
2   head value is updated based on a percentage of the selected amount of readahead data.

1   26. (Previously Presented) The storage system of claim 22, wherein the plurality of fac-  
2   tors used to select the amount of readahead data includes at least one of:

- 3           (i) the amount of client-requested data,  
4           (ii) a number of client read requests processed in the read stream, and  
5           (iii) a read-access style associated with the data container.

1   27. (Original) The storage system of claim 22, wherein the selected amount of readahead  
2   data is doubled if the number of client read requests processed in the read stream is  
3   greater than a first threshold value.

1 28. (Currently Amended) A computer-readable media comprising instructions for execu-  
2 tion in a processor for the practice of a method for a storage operating system imple-  
3 mented in a storage system to optimize the amount of readahead data retrieved for a read  
4 stream established in a data container stored in the storage system, the method compris-  
5 ing:

6 receiving a client read request at the storage system, the client read request indi-  
7 cating client-requested data for the storage operating system to retrieve from the data  
8 container containing the read stream;

9 determining whether the storage operating system is permitted to retrieve reada-  
10 head data from the data container in response to the received client read request;

11 if it is determined that the storage operating system is permitted to retrieve reada-  
12 head data from the data container, performing the steps of:

13 (i) selecting an amount of readahead data to retrieve from the data container  
14 based on a plurality of factors stored within a readset data structure associ-  
15 ated with the read stream; and

16 (ii) retrieving the selected amount of readahead data from the data container.

1 29. (Original) The computer-readable media of claim 28, wherein the data container is a  
2 file, directory, vdisk or lun.

1 30. (Previously Presented) The method of claim 1, wherein the retrieved readahead data  
2 is stored in one or more buffers, the buffers containing a flush queue, the flush queue be-  
3 ing configured to reuse buffers after a predetermined period of time.

1 31. (Previously Presented) The method of claim 30, wherein the read stream corresponds  
2 to a read-once data transfer and data retrieved from the data container is stored in the  
3 flush queue.

1 32. (Previously Presented) The method of claim 30, wherein the retrieved readahead data  
2 is stored in the flush queue.

1 33. (Previously Presented) The method of claim 30, wherein one or more buffers ac-  
2 cessed from the flush queue are re-enqueued on a normal queue.

1 34. (Currently Amended) A method for optimizing readahead data retrieval for a read  
2 stream established in a data container stored in a storage system, the method comprising:  
3 receiving a client read request at the storage system, the client read request be-  
4 longing to the read stream and indicating an amount of client-requested data;  
5 selecting an amount of readahead data based on the indicated amount of client-  
6 requested data stored within a readset data structure associated with the read stream; and  
7 retrieving the selected amount of readahead data from the data container.

1 35. (Previously Presented) The method of claim 34, wherein the selected amount of  
2 readahead data is set equal to a multiple of a predetermined amount, and wherein the  
3 multiple is associated with the amount of client-requested data.

1 36. (Previously Presented) The method of claim 34, wherein the selected amount of  
2 readahead data is set equal to a multiple of the amount of client-requested data.

1 37. (Previously Presented) The method of claim 36, further comprising the step of  
2 rounding the selected amount of readahead data to the size of a data block.

1 38. (Previously Presented) The method of claim 34, wherein the selected amount of  
2 readahead data is set equal to a predetermined upper limit.

1 39. (Currently Amended) A method for optimizing readahead data retrieval for a read  
2 stream established in a data container stored in a storage system, the method comprising:

3           receiving a client read request at the storage system, the client read request be-  
4           longing to the read stream and indicating client-requested data;  
5           selecting an amount of readahead data based on a read-access style associated  
6           with the data container, wherein the read-access style is stored within a readset data struc-  
7           ture associated with the read stream; and  
8           retrieving the selected amount of readahead data from the data container.

1   40. (Previously Presented) The method of claim 39, wherein the selected amount of  
2   readahead data equals zero if the read-access style corresponds to a random read-access  
3   style.

1   41. (Previously Presented) A method for optimizing readahead data retrieval for a read  
2   stream established in a data container stored in a storage system associated with a number  
3   of storage devices, the method comprising:  
4           receiving a client read request at the storage system, the client read request be-  
5           longing to the read stream and indicating client-requested data;  
6           selecting an amount of readahead data based on the number of storage devices;  
7           and  
8           retrieving the selected amount of readahead data from the data container.

1   42. (Previously Presented) The method of claim 41, wherein the step of selecting an  
2   amount of readahead data further comprises:  
3           determining whether a flag is associated with the read stream, the flag indicating  
4           that the storage system is associated with more than a predetermined number of storage  
5           devices; and  
6           in response to determining whether the flag is associated, selecting the amount of  
7           readahead data.



1 43. (Previously Presented) The method of claim 41, wherein the storage devices com-  
2 prise one or more disks.

1 44. (Currently Amended) A method for optimizing readahead data retrieval for a read  
2 stream established in a data container stored in a storage system, the method comprising:  
3 receiving a client read request at the storage system, the client read request be-  
4 longing to the read stream and indicating client-requested data;  
5 selecting an amount of readahead data based on a plurality of factors stored within  
6 a readset data structure associated with the read stream; and  
7 retrieving the selected amount of readahead data from the data container.

1 45. (Previously Presented) The method of claim 44, wherein the retrieved readahead  
2 data is stored in one or more buffers, the buffers containing a flush queue, the flush queue  
3 being configured to reuse buffers after a predetermined period of time.

1 46. (Previously Presented) The method of claim 45, wherein the read stream corre-  
2 sponds to a read-once data transfer and data retrieved from the data container is stored in  
3 the flush queue.

1 47. (Previously Presented) The method of claim 45, wherein the retrieved readahead  
2 data is stored in the flush queue.

1 48. (Previously Presented) The method of claim 45, wherein one or more buffers ac-  
2 cessed from the flush queue are re-enqueued on a normal queue.

1 49. (Currently Amended) A system for optimizing readahead data retrieval for a read  
2 stream established in a data container stored in a storage system, the system comprising:  
3 means for receiving a client read request at the storage system, the client read re-  
4 quest belonging to the read stream and indicating client-requested data;

5        means for selecting an amount of readahead data based on a plurality of factors  
6        stored within a readset data structure associated with the read stream; and  
7        means for retrieving the selected amount of readahead data from the data con-  
8        tainer.

1        50. (Previously Presented) The system of claim 49, wherein the retrieved readahead data  
2        is stored in one or more buffers, the buffers containing a flush queue, the flush queue be-  
3        ing configured to reuse buffers after a predetermined period of time.

1        51. (Previously Presented) The system of claim 50, wherein the read stream corresponds  
2        to a read-once data transfer and data retrieved from the data container is stored in the  
3        flush queue.

1        52. (Previously Presented) The system of claim 50, wherein the retrieved readahead data  
2        is stored in the flush queue.

1        53. (Previously Presented) The system of claim 50, wherein one or more buffers ac-  
2        cessed from the flush queue are re-enqueued on a normal queue.

1 Please add new claims 54 *et al.*

1 54. (New) A method, comprising:  
2 receiving a plurality of client read requests at a storage system, the client read re-  
3 quests indicating client-requested data sets for a storage operating system to retrieve from  
4 one or more data containers containing one or more read streams;  
5 selecting an amount of readahead data to retrieve from the one or more data con-  
6 tainers based on a plurality of factors stored within a readset data structure associated  
7 with each read stream;  
8 retrieving the selected amount of readahead data from the data container;  
9 processing one or more of the plurality of client read requests; and  
10 adjusting, as client requests are processed, the plurality of factors stored within  
11 the readset data structure associated with each read stream to optimize amount of reada-  
12 head data is cached for each read stream.

1 55. (New) The method of claim 54, further comprising:  
2 determining whether the storage operating system is permitted to retrieve reada-  
3 head data from the one or more data containers in response to each received client read  
4 request.

1 56. (New) The method of claim 54, wherein the one or more data containers are at least  
2 one of a file, a directory, a vdisk or a lun.

1 57. (New) The method of claim 55, wherein the storage operating system is determined  
2 to be permitted to retrieve readahead data from the one or more data containers when the  
3 client-requested data extends the read stream past a predetermined next readahead value.

1 58. (New) The method of claim 57, wherein the predetermined next readahead value is  
2 stored in a readset data structure associated with the read stream.

1 59. (New) The method of claim 57, wherein the predetermined next readahead value is  
2 updated based on a percentage of the selected amount of readahead data.

1 60. (New) The method of claim 54, wherein a read-access style associated with the one  
2 or more data containers is one of the plurality of factors used to select the amount of  
3 readahead data.

1 61. (New) The method of claim 60, wherein the selected amount of readahead data equals  
2 zero if the read-access style corresponds to a random read-access style.

1 62. (New) The method of claim 54, wherein a number of client read requests processed  
2 in the read stream is one of the plurality of factors used to select the amount of readahead  
3 data.

1 63. (New) The method of claim 62, wherein the number of client read requests processed  
2 in the read stream is stored as a count value in a readset data structure associated with the  
3 read stream.

1 64. (New) The method of claim 54, wherein the amount of client-requested data is one  
2 of the plurality of factors used to select the amount of readahead data.

1 65. (New) The method of claim 64, wherein the selected amount of readahead data is set  
2 equal to a predetermined upper limit for large amounts of client-requested data.

1 66. (New) The method of claim 54, wherein the selected amount of readahead data is  
2 doubled if the number of client read requests processed in the read stream is greater than  
3 a first threshold value.

1 67. (New) The method of claim 55, wherein the client-requested data is identified as  
2 read-once data when either (i) the number of client read requests processed in the read  
3 stream is greater than a second threshold value or (ii) a set of metadata associated with  
4 the read stream indicates that the client-requested data is read-once data.

1 68. (New) The method of claim 54, wherein the selected amount of readahead data is  
2 stored in one or more buffers enqueued on a flush queue, the flush queue being config-  
3 ured to reuse buffers after a predetermined period of time.